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SPECIAL CLIMATE STATEMENT 28

Extreme daily rainfall recorded in Mildura and across the Melbourne Metropolitan region

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*Victorian Climate Services Centre
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Tropical storms bring extreme rainfall to Victoria, particularly Mildura and Melbourne

Tropical moisture interacted with a cold front, triggering extreme rainfall across the Melbourne Metropolitan area, the North Mallee district and much of eastern Victoria between the 4th and the 6th of February 2011. Daily rainfall totals between 100–200 mm were widespread in the eastern and southeastern suburbs of Melbourne and were the equivalent of what most stations would usually observe in an entire summer season. The exceptionally high daily rainfall totals resulted in severe flash flooding in numerous locations, with the southeastern suburbs of Melbourne and the regional town of Mildura amongst the most severely affected.

Synoptic summary

Severe thunderstorms developed over Victoria on the 4th of February 2011 within a very tropical airmass, a remnant of Tropical Cyclone Anthony. High levels of moisture associated with ex-Tropical Cyclone Yasi, located over central Australia at the time, also fed into the system.

A slow moving surface low pressure trough extended from central Australia, through Mildura and Melbourne, into northeastern Tasmania on the afternoon and evening of the 4th, providing the focus for the formation of the most intense and severe thunderstorms of this event. The persistence of the trough provided conditions that allowed thunderstorms to develop one after the other, affecting Mildura and the southeastern suburbs of Melbourne over a period of nearly 12 hours. Extremely high humidity and strong winds were associated with the storms, which, in just 24 hours, delivered more than 100 mm to most areas of Metropolitan Melbourne. Particularly heavy falls occurred in the southeastern parts of Melbourne (Figure 1a).

A number of storms, which developed during the afternoon and evening of the 4th, exhibited supercellular characteristics, with evidence of a damaging microburst associated with a thunderstorm to the west of Melbourne. Winds and damage consistent with a microburst were reported at the Laverton AWS when wind speed strengthened from almost calm at 19:41 local time on Friday, to a west-northwesterly maximum gust of 131 km/h at 19:46, to a southwesterly maximum gust of 111 km/h at 19:47, to a southeasterly maximum gust of 65 km/h at 19:48, after which there was an instrument failure. A large number of birds were killed in the vicinity of the weather station and there was damage to vegetation and structures within an area of about a square kilometre, which suggested a period of violent weather. Mildura also experienced extreme and long lasting pulse like storm activity on the afternoon and evening of the 4th, receiving more than 50 mm in under an hour and over 100 mm in approximately 4 hours.

A cold front slowly crossed Victoria on the afternoon and evening of the 5th, replacing the tropical airmass and delivering an additional 30 to 50 mm to the east of the state in the 24 hours to 9am on the 6th (Figure 1b).

Rainfall records

This rainfall event is one of the most intense ever observed in the Melbourne Metropolitan area and the most extreme recorded in Mildura in over 100 years of records. More than 65% of Victoria recorded daily rainfall totals in the 99th percentile for February in the 24 hours to 9am on the 5th, whilst approximately 7% of the state observed the highest daily rainfall on record on the same day. Approximately 40 stations throughout Victoria recorded multi-day rainfall totals over 140 mm between the 4th and 6th (Table 1). The highest multi-day totals were observed in the northeast of the state, with some alpine stations receiving around 200 mm over three days. Mildura received 178.8 mm in two days, more than half the typical annual total for this site.

Lyndhurst recorded the highest official daily rainfall of the event, with 179.6 mm recorded in the 24 hours to 9am on the 5th, whilst Mildura Airport, in the northwest of the state, observed 147.4 mm.

The total at Mildura is the highest daily total observed for Mildura, exceeding the previous daily record of 91.2 mm on the 24th of March 1969 and also surpassing the record at the old Post Office site of 83.1 mm on the 8th of February 1911. Mildura has already almost doubled the previous highest February rainfall total for the site in just the first week of the month. Numerous stations recorded their highest daily rainfall for February (Table 2), with parts of the northwest and northeast of the state four times above the long-term average for February by the 7th (Figure 2). Moorabbin Airport and Glen Waverley Golf Course both recorded in excess of 140 mm, their highest daily rainfall for any time of year, almost tripling their average monthly rainfall for February in just 24 hours.

Experimental RADAR observations (Figure 3) available on the Bureau of Meteorology website indicate that a large area, in the east of Metropolitan Melbourne, was likely to have experienced rainfall totals in the 24 hours to 9am on the 5th of February of 150 mm and greater, with some areas appearing to have received in excess of 200 mm.

Extreme humidity

Very humid conditions have been a common feature of the 2010/2011 summer season, with the event of the 4th of February again close to record levels. Surface dewpoint temperatures in Melbourne hovered above 22 °C for three consecutive 3-hourly readings. This was the third longest stretch of such high humidity on record, behind February 1955 and January 2011, with six and four consecutive readings respectively. Dewpoint temperatures also came close to breaking the record in Mildura, with 24.4 °C recorded at 3am on the 5th, the highest dewpoint for this station at this time of day for February, but lower than the February record of 25 °C from both 3pm and 6pm in 1948 and 1973. The exceptional nature of the February 2011 event in Mildura was defined by the persistence of very high dewpoints with 18 consecutive 3-hourly readings above 22 °C, breaking the previous record for February of 15 consecutive readings in 1999.

A more representative evaluation of the humidity of the atmosphere is the precipitable water value, which is a measure of the moisture content through the full depth of the atmosphere, as measured by a weather balloon. The long-standing Melbourne record is a value of 54.5 mm, which was recorded in February 1973. This record has now been surpassed twice in 2011, firstly on the 13th of January, with an unprecedented 65.2 mm, and again on the 4th of February, with a value of 58.5 mm. These values are extraordinary, as precipitable water content in Melbourne is usually around 20 mm during summer, with values greater than 50 mm more typical of tropical locations such as Darwin. The record high humidity explains the extreme nature of rainfall during both January (see Special Climate Statement 26, <http://www.bom.gov.au/climate/current/statements/scs26.pdf>) and February 2011 and is part of a broader pattern of unusually high humidity that has affected eastern Australia for much of the last six months.

Comparison to the 1973 event

The recent event is comparable in some measures to the 4th - 6th February 1973 event. The event of 1973 had a greater spatial extent, with higher rainfall to the west of Melbourne, whereas the 2011 event was concentrated more to eastern, central and northern parts of the state. Daily rainfall totals were very similar, with 100-150 mm falling in the 24 hours to 9am on the 6th of February 1973. The Victorian area-averaged daily rainfall totals from the 6th of February 1973 still stand as the highest for any single day in Victoria, with 49.43 mm. The area-averaged rainfall for the 5th of February 2011 of 36.13 mm was well below the 1973 record, but still exceeded the long-term average for Victoria for the entire month of February (31.97 mm).

The very high humidity associated with the February 2011 event far exceeded that experienced in the 1973 event at Melbourne, in which only two readings of dewpoint temperature exceeded 20 °C, compared to six in the 2011 event.

Impacts

The deluge associated with the convective thunderstorms which persisted across Melbourne between the evening of the 4th and midday on the 5th, resulted in flash flooding across the Metropolitan area. Victoria-wide the State Emergency Services (SES) received in the order of 6000 requests for assistance associated with this event.

Prior to the February rain event, a major flood warning for the Loddon River and moderate to minor flood warnings for the Murray River, were current, and are continuing as of the 8th of February. The heavy rain fell on catchments already saturated by the December and January rain events leading to widespread riverine flooding, the details of which are provided in the following description. Major flood warnings were issued for the Bunyip River, Dandenong Creek and Sunday Creek, whilst moderate flood warnings were issued for the Upper Murray, Kiewa, Buffalo and Mitta Mitta Rivers in the northeast, Campaspe River in the northwest, as well as the Werribee River, Yarra River and Dandenong Creek in the southeast. Minor flood warnings were issued for Diamond Creek, Merri Creek, Seven and Castle Creeks, Mount Emu Creek, Avoca, Broken, Goulburn, Ovens and King, Barwon and Moorabool, Werribee and Latrobe Rivers.

Large-scale climate drivers

The past 6 to 12 months have been particularly wet across the state, but particularly north of the Divide. In 2010 Victoria recorded its wettest year since 1974 and the fifth wettest year on record, whilst Melbourne experienced its first year of above average rainfall since 1996. Persistent rainfall from September through to December meant that catchments were already wet before the record breaking rainfall events of January and February 2011. The 2010/2011 summer already ranks as Victoria's wettest summer on record, with three weeks of the season remaining.

The rainfall events of the past 6 months have been associated with record warm sea surface temperatures to the north of Australia in both the Pacific and Indian Oceans. Sea surface temperatures for 2010 in the Australian region were 0.54 °C above the long-term average and the highest on record. Record warm sea surface temperatures have combined with one of the strongest La Niña events in the Pacific Ocean on record, to produce unprecedented rainfall across much of Australia.

Further information

The information in this statement is based on preliminary data available as of Thursday 10 February 2011 and may change as further data are obtained and quality assurance is undertaken.

Further information can be obtained from the following contacts:

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Figures

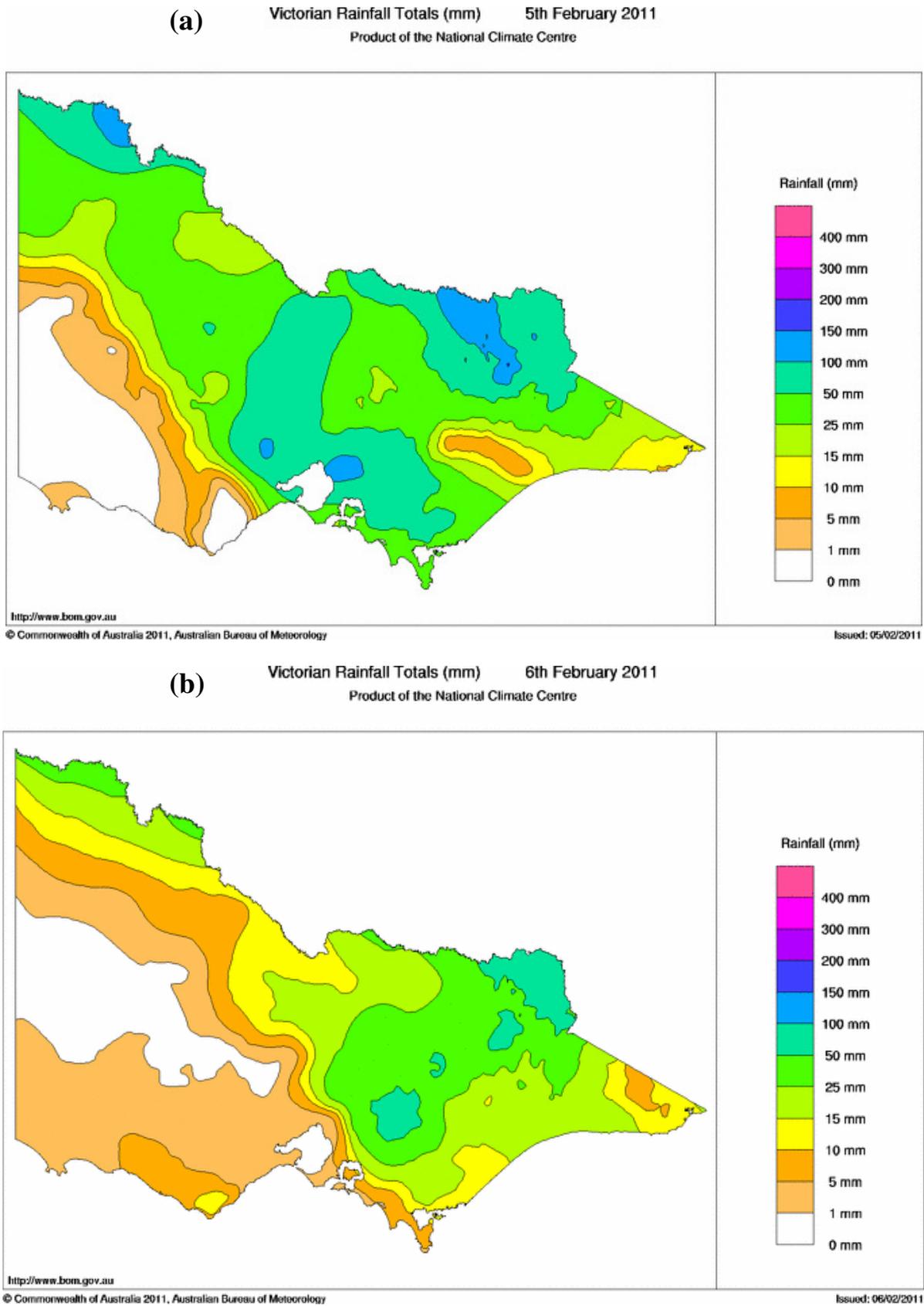


Figure 1: Rainfall totals for Victoria for the 24 hours to 9am on the 5th of February 2011 (a) and 6th of February 2011 (b)

Rainfall Percentages 1st to 8th February 2011
Product of the National Climate Centre

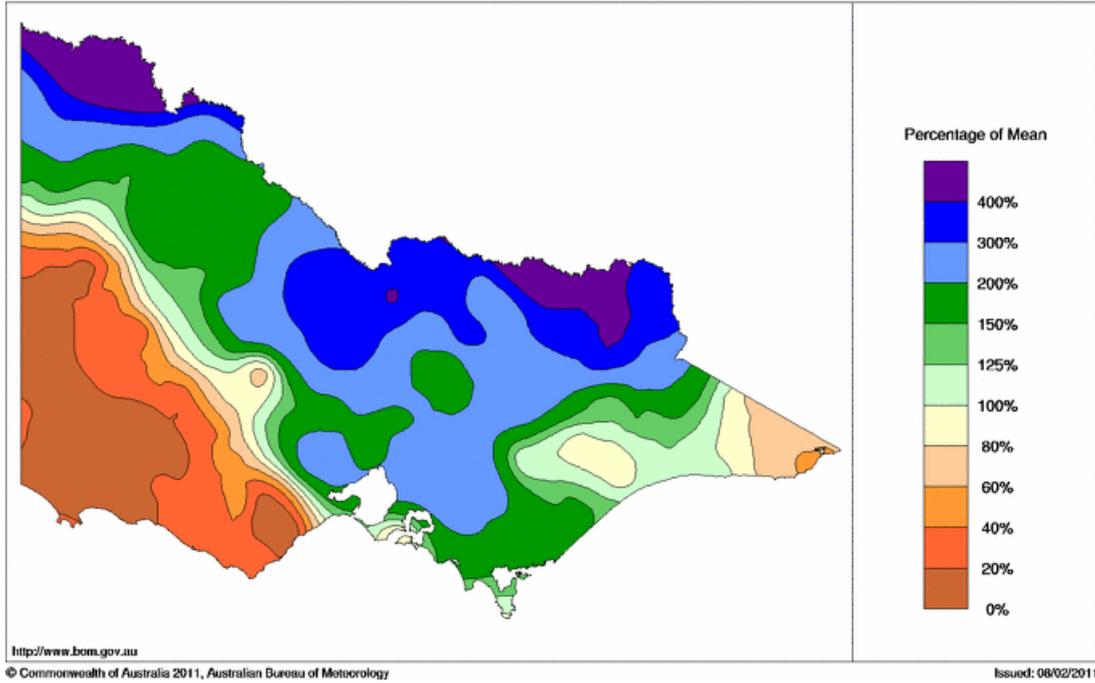


Figure 2: Rainfall Percentages for Victoria (compared to February average) for the week ending 8th February 2011

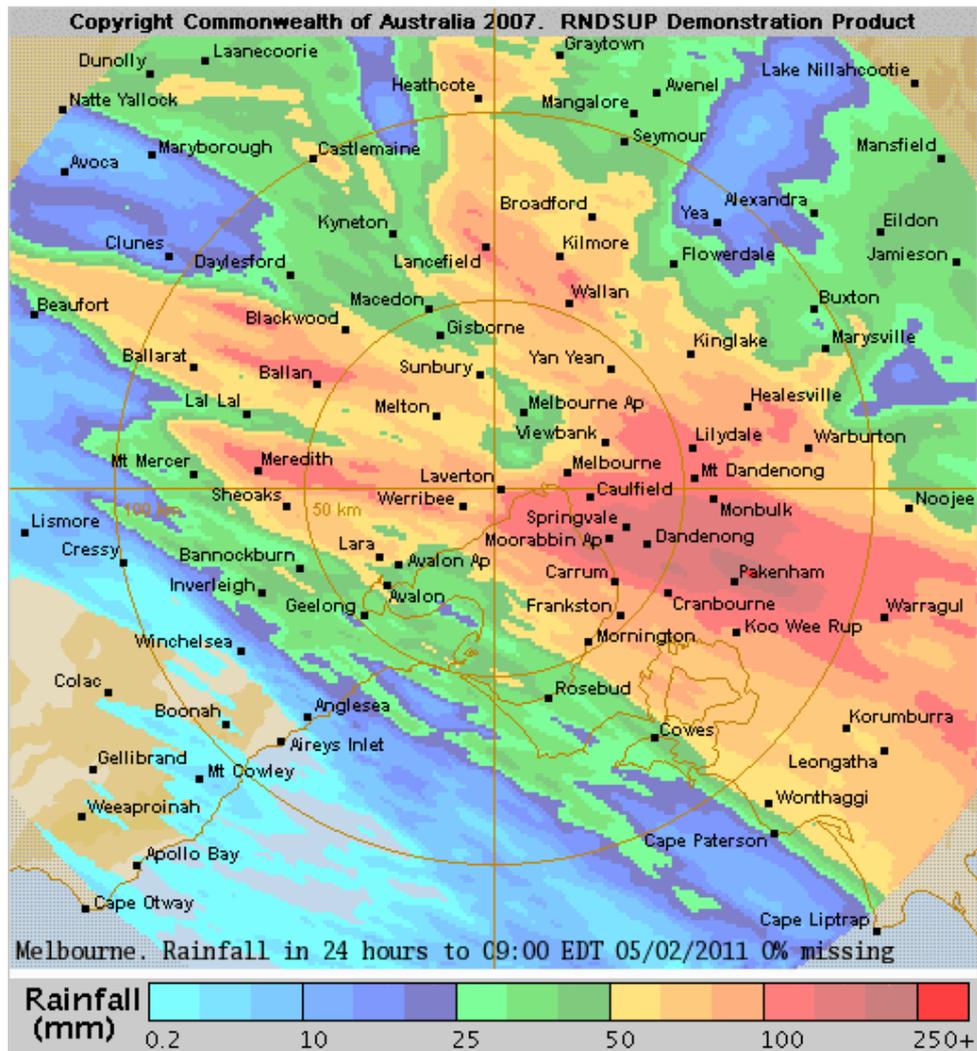


Figure 3: Radar estimated rainfall totals in the vicinity of the Laverton Radar for the 24 hours to 9am on the 5th of February 2011.

Tables

Station Name	Rainfall (mm) Friday 4-Feb-11	Rainfall (mm) Saturday 5-Feb-11	Rainfall (mm) Sunday 6-Feb-11	Multi-day Total (mm)
Falls Creek	40.4	104.2	61.6	206.2
Mount Hotham	35.0	90.8	73.2	199.0
Mount Buller	63.2	47.8	84.0	195.0
Lyndhurst	2.4	179.6	8.0	190.0
Gembrook	18.4	124.0	46.8	189.2
Cardinia Reservoir	2.8	169.0	16.4	188.2
Pakenham Upper	3.2	158.8	20.0	182.0
Iona	5.6	151.4	21.8	178.8
Mildura Airport	0.0	147.4	31.4	178.8
Berwick	5.2	166.4	7.0	178.6
Dunns Hill/Ferny Creek	7.0	136.0	32.8	175.8
Keysborough	2.8	161.4	7.2	171.4
Narre Warren North	8.6	156.2	4.8	169.6
Hampton Park	3.0	159.0	4.0	166.0
Willow Grove	2.0	116.0	46.2	164.2
Jindivick	17.4	98.0	46.0	161.4
Glen Waverley	8.0	147.4	2.0	157.4
Drouin Bowling Club	6.2	110.0	40.4	156.6
Rutherglen Research	14.2	114.0	28.4	156.6
Tanjil South	1.6	103.6	48.4	153.6
Chiltern	10.8	111.4	31.0	153.2
Mentone	1.6	148.0	3.2	152.8
Lake Buffalo D/S	17.2	91.2	43.0	151.4
Silvan Reservoir	21.6	100.6	28.4	150.6
Carboor Upper	36.0	75.6	38.6	150.2
Beechworth Woolshed	4.4	110.8	34.0	149.2
Moorabbin Airport	1.2	140.8	3.4	145.4
Meredith	6.0	136.0	2.8	144.8
Eurobin	19.2	95.6	29.6	144.4
Eldorado	6.6	115.8	21.8	144.2
Officer	4.2	134.2	5.6	144.0
Mullidolongong	4.4	97.4	41.4	143.2
Oakleigh	4.0	138.7	0.0	142.7
Osborne's Flat	6.6	80.0	54.8	141.4
Granite Flat	4.8	82.4	53.8	141.0
Hunters Hill	3.6	79.6	57.2	140.4

Table 1: Rainfall totals for stations recording more than 140 mm between 9am on the 4th and 9am on the 6th of February

Station Name	Rainfall and Date	Previous wettest February day	Annual Extreme
Mildura Airport	147.4 mm 05th	65.2 mm 21 Feb 2000	91.2 mm 24 Mar 1969
Wedderburn (Post Office)	111.0 mm 04th	61.0 mm 09 Feb 1911	84.0 mm 14 Jan 2011
Kyabram	65.8 mm 05th	52.4 mm 03 Feb 2005	105.9 mm 4 Oct 1993
Rutherglen Research	114.0 mm 05th	90.9 mm 19 Feb 1928	114.3 mm 8 Jan 1934
Mitta Mitta Forestry	76.6 mm 05th	66.5 mm 20 Feb 1973	108.0 mm 26 Aug 1983
Burrowye Station	60.8 mm 06th	48.8 mm 19 Feb 1974	118.0 mm 25 Jan 1991
Tawonga	85.0 mm 05th	71.1 mm 20 Feb 1973	144.2 mm 9 Dec 2010
Lake Buffalo	88.4 mm on 05th	80.8 mm 4 Feb 2005	156.6 mm 4 Oct 1993
Drouin Bowling Club	110.0 mm 05th	98.6 mm 26 Feb 1946	180.1 mm 1 Dec 1934
Mirboo North Water Board	82.0 mm 05th	76.0 mm 08 Feb 2002	102.9 mm 20 Mar 1970
Cheltenham Kingston Centre	112.0 mm 05th	87.6 mm 06 Feb 1973	111.8 mm 15 Nov 1920
Moorabbin Airport	140.8 mm 05th	89.2 mm 06 Feb 1973	91.0 mm 13 Jan 1998
Oakleigh	138.7 mm 05th	109.0 mm 3 Feb 2005	109.0 mm 3 Feb 2005
Bonbeach (Carrum)	112.0 mm 05th	98.0 mm 3 Feb 2005	98.0 mm 3 Feb 2005
Glen Waverley (Golf Course)	147.4 mm 05th	130.4 mm 3 Feb 2005	130.4 mm 3 Feb 2005
Ballan	119.4 mm 05th	110.5 mm 06 Feb 1973	118.4 mm 1 Dec 1933
Laverton Raaf	117.8 mm 06th	99.8 mm 03 Feb 2005	188.0 mm 8 Apr 1977
Meredith (Darra)	136.0 mm 05th	125.2 mm 6 Feb 1973	125.2 mm 6 Feb 1973
Castlemaine Prison	101.2 mm 05th	71.4 mm 06 Feb 1973	91.2 mm 13 Jan 1973

Table 2: Record highest February daily rainfall totals for stations with more than 20 years of record (annual extremes are highlighted in bold)